DEVELOPING CARTRIDGE, SIDE COVER MOUNTING METHOD AND ELECTROPHOTOGRAPHIC IMAGE FORMING APPARATUS

FIELD OF THE INVENTION AND RELATED ART

The present invention relates to a development cartridge, an electrophotographic image forming apparatus in which a development cartridge is removably mountable, a method for attaching one of the two end covers of a development cartridge, and a method for attaching the other end cover of the development cartridge.

Here, an electrophotographic image forming apparatus means an apparatus for forming an image on recording medium with the use of an electrophotographic image formation process. For example, it includes electrophotographic copying machines, electrophotographic printers (LED printers, laser beam printers, etc.), electrophotographic facsimileing machines, electrophotographic wordprocessors, etc.

In the field of an image forming apparatus, a development cartridge system, that is, a system in which the developing members for developing an electrostatic latent image formed on the electrophotographic photoconductive member are disposed in a cartridge, which comprises a storage portion for storing developer (which hereinafter will

be referred to as "toner"), and which is removably mountable in the main assembly of the image forming apparatus, has been widely employed.

The development cartridge system allows a user to maintain an image forming apparatus without relying on a service person, drastically improving an image forming apparatus in terms of operational efficiency. Thus, the cartridge system has been widely used in the field of an electrophotographic image forming apparatus.

Some of the development cartridges employed by a development cartridge system have been known for the side covers, which are attached to the lengthwise ends of the cartridge frame, one for one (U.S. Patent 5,966,566).

SUMMARY OF THE INVENTION

The present invention is a further development of the prior arts described above.

The primary object of the present invention is to provide a development cartridge superior to development cartridges in accordance with the prior arts, in terms of the efficiency with which the side covers are attached to a cartridge frame, a method for attaching the side covers, and an electrophotographic image forming apparatus.

Another object of the present invention is to

provide a development cartridge superior to development cartridges in accordance with the prior arts, in terms of the accuracy with which side covers are attached to a cartridge frame, a method for attaching the side covers, and an electrophotographic image forming apparatus.

Another object of the present invention is to provide a development cartridge superior to development cartridges in accordance with the prior arts, in terms of how solidly the side covers are attached to a cartridge frame, a method for attaching the side covers, and an electrophotographic image forming apparatus.

Another object of the present invention is to provide a development cartridge, the side covers of which are reinforced by being attached to a cartridge frame, to prevent the side covers from deforming when the position of the development cartridge relative to the main assembly of an electrophotographic image forming apparatus is fixed by a part of each side cover when the development cartridge is mounted into the main assembly of the image forming apparatus, and thereafter, being therefore superior to development cartridges in accordance with the prior arts, in terms of the accuracy with which the development cartridge is positioned relative to the main assembly of an electrophotographic image forming apparatus, a method

for attaching the side covers, and an electrophotographic image forming apparatus.

These and other objects, features, and advantages of the present invention will become more apparent upon consideration of the following description of the preferred embodiments of the present invention, taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a sectional view of the main assembly of an electrophotographic color image forming apparatus in accordance with the present invention.

Figure 2 is a sectional view of the main portion of a process cartridge mountable in an electrophotographic color image forming apparatus in accordance with the present invention.

Figure 3 is a sectional view of the development cartridge in the first embodiment of the present invention.

Figure 4 is a perspective view of the development cartridge in the first embodiment of the present invention.

Figure 5 is a side view of the lengthwise end of the development cartridge, from which the development cartridge is driven.

Figure 6 is a plan view of the development

cartridge in Figure 4, as seen from the photoconductive drum side.

Figure 7 is a bottom view of the development cartridge in Figure 4.

Figure 8 is a perspective view of the partially exploded view of the development cartridge in Figure 4, for showing how one of the side covers is attached.

Figure 9 is a perspective view of the side covers shown in Figure 4, for showing the outward side of the side cover.

Figure 10 is a perspective view of the side cover in Figure 4, for showing the inward side thereof.

Figure 11 is a perspective view of the rotary of the main assembly of the image forming apparatus, and one of the development cartridges, in the first embodiment of the present invention, for showing how the latter is mounted into the former.

Figure 12 is a perspective view of the rotary disk, for showing the structure thereof for accommodating development cartridges.

Figure 13 is a plan view of a development cartridge and one of the rotary discs, for showing how the former is engaged with the latter.

Figure 14 is a perspective view of the driving force transmission gear train for driving a

development cartridge.

Figure 15 is a drawing for showing how the gear of a development cartridge meshes with the gear of the driving force transmission gear train as the development cartridge is moved into its development position.

Figure 16 is a drawing for showing the engagement between the gears of the development cartridge in its development position, and the gears of the driving force transmission gear train.

Figure 17 is a perspective view of a part of the rotary, on the side from which the rotary is not driven, for describing in detail the connection between the electrical contact point on the main assembly side of the image forming apparatus and the electrical contact point on the development cartridge side, in the first embodiment of the present invention.

Figure 18 is a sectional view of the rotary, on the side from which the rotary is not driven, and the corresponding lengthwise end of a development cartridge, for describing in detail how the development cartridge is positioned relative to the rotary in terms of the lengthwise direction of the development cartridge, and how the electrical contact point on the main assembly side is connected to the electrical contact point on the development cartridge

side.

Figure 19 is also a perspective view of a part of the rotary, on the side from which the rotary is not driven, and the corresponding lengthwise end of a development cartridge, for describing in detail how the development cartridge is positioned relative to the rotary in terms of the lengthwise direction of the development cartridge, and how the electrical contact point on the main assembly side is connected to the electrical contact point on the development cartridge side.

Figure 20 is a perspective view of the development cartridge in the second embodiment of the present invention.

Figure 21 is a perspective view of one of the side covers of the development cartridge in Figure 20, for showing the outward side of the side cover.

Figure 22 is a perspective view of the side cover in Figure 20, for showing the inward side thereof.

Figure 23 is a sectional view of the lengthwise end of the rotary, on the side from which the rotary is not driven, and the corresponding lengthwise end of a development cartridge, in the second embodiment of the present invention, for describing, in detail, how the development cartridge is positioned relative to the rotary in terms of the

lengthwise direction of the development cartridge, and how the electrical contact point on the main assembly side is connected to the electrical contact point on the development cartridge side.

Figure 24 is a perspective view of one of the lengthwise ends of the cartridge frame, and one of the bearing members, for showing how the bearing member is attached to the lengthwise end of the cartridge frame.

Figure 25 is a perspective view of one of the lengthwise ends of the cartridge frame, and one of the side covers, for showing how the side cover is attached to the lengthwise end of the cartridge frame.

Figure 26 is a schematic drawing of the cartridge frame, bearing member, and side cover, showing how the bearing member and side cover are attached to the cartridge frame.

Figure 27 is a perspective view of the other lengthwise end of the cartridge frame, and the corresponding bearing member, showing how the bearing member is attached to the cartridge frame.

Figure 28 is a perspective view of the lengthwise end of the cartridge frame, shown in Figure 27, and the corresponding side cover, and how the side cover is attached to the cartridge frame.

Figure 29 is a schematic drawing of the

cartridge frame, bearing member, and side cover, showing how the bearing member and side cover are attached to the cartridge frame.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Hereinafter, a development cartridge, an electrophotographic image forming apparatus, a method for attaching one of the side covers, and a method for attaching the other side cover, in accordance with the present invention, will be described in more detail with reference to the appended drawings.

(Embodiment 1)

Figure 1 shows one of the preferred embodiments of an electrophotographic image forming apparatus, more specifically, a color laser beam printer, in accordance with the present invention. In the following description of this embodiment, the "front side" of the apparatus means the upstream side (right side in Figure 1) in terms of the direction in which recording medium (transfer medium) is conveyed from the transfer station to the fixation station. The "left or right side" of the main assembly of the apparatus means the left or right side as seen from the front side of the apparatus, and the "left or right side" of a process cartridge means the left or right side of the process cartridge as seen from the front side of the apparatus in the proper position in

the main assembly of the apparatus. The "lengthwise direction" is the direction parallel to the surface of the recording medium in the apparatus, and is intersectional (virtually perpendicular) to the direction in which the recording medium is conveyed.

(General Structure of Electrophotographic Color Image Forming Apparatus)

First, the general structure of the electrophotographic color image forming apparatus A will be described with reference to Figures 1 and 2.

The color laser beam printer A in this embodiment comprises: four development cartridges 4, more specifically, a yellow component developing device 4Y, a magenta component developing device 4M, a cyan component developing device 4C, and a black component developing device Bk; a process cartridge 5 comprising a photoconductive drum unit 20 and an intermediary transfer unit 21; and the main assembly 100 in which the development cartridges 4 and process cartridge 5 are removably mountable.

Referring to Figure 1, in the image forming apparatus main assembly 100, an optical image formed in accordance with image formation data is projected from an exposing means 3 to form an electrostatic latent image on a photoconductive drum 1 uniformly charged by a charging apparatus 2. The formed latent image is developed into a visible image (which

hereinafter may be referred to as "toner image") by one of the development cartridges 4 which make up a part of a developing apparatus 4A. The toner image is transferred onto an intermediary transfer member 5a by a first transferring means 5j as a transferring apparatus.

The toner image on the intermediary transfer member 5a is transferred by a second transferring means 11 onto a recording medium being conveyed by a conveying means in synchronism with the formation of the toner image. Then, the transfer medium is conveyed to a fixing means 8 comprising a pressure roller 8a and heat roller 8b. In the fixing means 8, the toner image on the transfer medium is permanently fixed to the transfer medium. Thereafter, the recording medium is discharged into a delivery tray 10.

Next, referring to Figure 2, in this embodiment, the photoconductive drum 1, an intermediary transfer belt 5a, and a waste toner box 216, are integrated in the form of a process cartridge 5, which is made up of two units: photoconductive drum unit 20 which contains the photoconductive drum 1, and an intermediary transfer member unit 21 which contains the intermediary transfer belt 5a and waste toner box 216.

The intermediary transfer belt unit 21 has a

means (intermediary transferring means) for transferring a toner image from the photoconductive drum 1 onto a recording medium with the use of the intermediary transfer belt 5a, and a means (waste toner recovering-storing means) for recovering the waste toner and storing it.

The intermediary transfer belt 5a is stretched around two rollers, which are a driver roller 240 and follower roller 241. The process cartridge 5 has a primary transfer roller 5j, which is disposed in a manner to oppose the photoconductive drum 1 with the interposition of intermediary transfer belt 5a.

The process cartridge 5 also has a cleaning charge roller unit 223 for applying a predetermined amount of bias voltage to remove residual electrical charge from the residual toner, which in this case is the toner remaining on the intermediary transfer belt 5a. The cleaning charge roller unit 223 is disposed in a manner to oppose the driver roller 240.

The charge roller 5f of the cleaning charge roller unit 223 removes the residual electrical charge from the residual toner on the intermediary transfer belt 5a by applying the predetermined amount of bias voltage. After the removal of the residual electrical charge, the residual toner is electrostatically transferred back onto the photoconductive drum 1.

Then, the residual toner is removed (recovered) by a cleaning blade 6, and is accumulated in the waste toner box 216 as described before.

Referring again to Figures 1 and 2, the image formation process of the image forming apparatus structured as described above will be described in further detail.

The photoconductive drum 1 is rotated in the direction indicated by an arrow mark in Figure 1 (counterclockwise direction), in synchronism with the rotation of the intermediary transfer belt 5a. As a predetermined charge bias voltage is applied to the charge roller 2 as a charging apparatus, the peripheral surface of the photoconductive drum 1 is uniformly charged. Then, the uniformly charged peripheral surface of the photoconductive drum 1 is exposed by an exposing means 3; it is exposed to the optical image, corresponding to, for example, the yellow component, of an intended image. As a result, an electrostatic latent image corresponding to the yellow component of the intended image is formed on the peripheral surface of the photo-conductive drum 1.

The exposing means 3 is a means for projecting a beam of light onto the peripheral surface of the photoconductive drum 1 while modulating the beam of light with the image formation information

read through an external device or the like. The exposing means 3 comprises a laser diode, a polygon mirror, a scanner motor, a focusing lens, and a deflective mirror.

As image formation signals are given to the exposing means 3 from an external device or the like, the laser diode of the exposing means 3 emits a beam of light in response to the image formation signals. The emitted beam of light is projected as an image forming beam of light onto the polygon mirror, which is being rotated at a high speed by a scanner motor. As a result, the image forming beam of light is reflected by the polygon mirror, and is sent through the focusing lens. Then, it selectively exposes the peripheral surface of the photoconductive drum 1 after being reflected by the deflective mirror. Consequently, an electrostatic latent image is formed on the peripheral surface of the photoconductive drum 1.

The electrostatic latent image on the photoconductive drum 1 is developed into an image formed of toner of a predetermined color (which hereinafter will be simply referred to as toner image). More specifically, the electrostatic latent image is developed by moving a predetermined development cartridge 4 among the four development cartridges 4 to the development position at which the

predetermined component developing device opposes the photoconductive drum 1. Incidentally, the four development cartridges 4 mounted in the rotary 40 in this embodiment are a yellow component developing device 4Y, a magenta component developing device 4M, a cyan component developing device 4C, and a black component developing device 4Bk.

In other words, in this embodiment, as soon as an electrostatic latent image begins to be formed, the predetermined cartridge, for example, the yellow component developing device 4Y, in the developing apparatus 4A is orbitally moved into the development position. Then, a predetermined bias voltage is applied to adhere yellow toner to the electrostatic latent image to develop the electrostatic latent image.

Referring to Figure 3, the development cartridge 4 can be roughly dividable into two portions: a developer storage portion 302 as a toner container, and a development portion 301 which opposes the electrophotographic photoconductive drum 1. The toner storage portion 302 and development portion 301 are integrally held by the cartridge frame 300.

The toner storage portion 302 is filled with toner of a predetermined color, and is provided with a stirring means 303. As the stirring means 303 is rotated, the toner is conveyed by a predetermined

amount to the development portion 301. In the development position 301, the toner is supplied to the peripheral surface of the development roller 305 by the rotation of the toner supply roller 304 (developer supply roller) formed of sponge or the like material. After being supplied to the peripheral surface of the development roller 305, the toner is formed into a thin layer of toner by the development blade 332 in the form of a piece of thin plate, while being electrically charged by the friction between the toner and the development blade 332 as well as development roller 305. As the development roller 305 is further rotated, the thin layer portion of the toner on the development roller 305 is conveyed to the development position 301. In the development position 301, the electrostatic latent image on the photoconductive drum 1 is developed by the application of a predetermined development bias.

The toner which did not contribute to the development of the latent image on the photoconductive drum 1, that is, the toner which remained unused on the peripheral surface of the development roller 305, is scraped away by the toner supply roller 304. At the same time as the residual toner is scraped away by the toner supply roller 304, a fresh supply of toner is supplied onto the development roller 305 by the toner supply roller 304 so that the development

operation is continuously carried out by the freshly supplied portion of the toner on the development roller 305.

Referring again to Figures 1 and 2, after being formed on the photoconductive drum 1, the toner image (yellow toner image) is transferred (primary transfer) onto the intermediary transfer belt 5a by the application of bias voltage to a primary transfer roller 5j, as a first transfer transferring means, that is, the roller for keeping the intermediary transfer belt 5a pressed upon the photoconductive drum 1. The polarity of the bias voltage is opposite to that of the toner.

As the above described primary transfer of the yellow toner image ends, the next color component developing device, which in this embodiment is the magenta component developing device 4M, is orbitally moved into the development position at which it opposes the photoconductive drum 1. Then, the toner image of magenta color is transferred onto the intermediary transfer belt 5a through the same process as described above. This process is also carried out for the cyan and black color components. As a result, four toner images different in color are layered on the intermediary transfer belt 5a.

While the four toner images are layered on the intermediary transfer belt 5a, the secondary

transfer roller 11 as a second transferring means, and a cleaning charge roller 5f as a cleaning unit, are kept separated from the intermediary transfer belt 5a.

After the formation of the four toner images different in color on the intermediary transfer belt 5a, the secondary transfer roller 11 is pressed upon the intermediary transfer belt 5a as shown in Figure 1. In addition, in synchronism with the pressing of the secondary transfer roller 11 upon the intermediary transfer belt 5a, a recording medium, which has been kept on standby at a predetermined location in the adjacencies of a pair of registration rollers 7 as a transfer medium conveying means, is sent to the nip between the intermediary transfer belt 5a and secondary transfer roller 11.

The image forming apparatus is provided with a transfer medium sensor (front sensor) 14, which is disposed on the immediately upstream side of the pair of registration rollers 7 in terms of the transfer medium conveyance direction. The sensor 14 detects the leading edge of the transfer medium, and as it detects the leading edge, it interrupts the conveyance of the force for rotationally driving the pair of registration rollers 7 to the pair of registration rollers 7 in order to keep the recording medium on standby at the predetermined location.

The secondary transfer roller 11 is provided with bias voltage opposite in polarity to the toner. Therefore, as a recording medium is conveyed through the nip, the toner images on the intermediary transfer belt 5a are transferred (secondary transfer) all at once onto the surface of the recording medium.

After the secondary transfer of the toner images, the recording medium is conveyed by way of a conveyer belt unit 12 to a fixing device 8, in which the toner images are fixed. Thereafter, the transfer medium is further conveyed by a pair of discharge rollers 13 along a discharge guide 15. Then, the transfer medium is discharged by a pair of discharge rollers 9 into a delivery tray 10 located on top of the color image forming apparatus A. This concludes the image formation.

Meanwhile, the cleaning charge roller 5f is pressed upon the intermediary transfer belt 5a after the secondary transfer. Then, the residual electrical charge is removed by the application of a predetermined bias voltage, from the surface of the intermediary transfer belt 5a and the toner remaining on the intermediary transfer belt 5a after the secondary transfer.

The residual toner, from which electrical charge has been removed, is electrostatically transferred from the intermediary transfer belt 5a

onto the photoconductive drum 1, in the primary transfer nip; in other words, the surface of the intermediary transfer belt 5a is cleaned.

The toner which remained on the intermediary transfer belt 5a after the secondary transfer and has been transferred back onto the photoconductive drum 1 is removed (recovered) from the photoconductive drum 1 by the cleaning blade 6, is conveyed through a specified path (unshown), and is accumulated as waste toner in the waste toner box 216.

(Rotary, Development Cartridge, and Developing Apparatus)

Next, referring to Figures 4 - 13, the development cartridge 4 and developing apparatus 4A will be described.

The four development cartridges 4, that is, yellow component developing device 4Y, magenta component developing device 4M, cyan component developing device 4C, and black component developing device 4Bk, which contain yellow, magenta, cyan, and black toners, one for one, are firmly mounted in their predesignated positions in the rotary 40 of the developing apparatus 4A, as described previously.

First, the method for positioning each development cartridge 4 relative to the rotary 40 will be described.

Referring to Figures 11 - 13, the rotary 40

is rotatable about the central axis 51. It comprises the central axis 51, and a pair of rotary discs 400 (400A and 400B) fixed to the lengthwise ends of the central axis 51, one for one.

Rotary discs 400 (400A and 400B) are provided with: four guiding grooves 400b for guiding one of the development cartridges 4 when mounting or dismounting the development cartridge 4; four cartridge positioning grooves 400h, against the bottom surface of which the development cartridge 4 is butted to be positioned relative to the rotary 40 in terms of the lengthwise direction of the development cartridge 4; four positioning boss holding receptacles 400d, each of which supports a development cartridge 4 by its positioning boss in a manner to allow the development cartridge 4 to pivot, and also function as cartridge positioning portions; and four V-shaped receptacle 400e for preventing the development cartridge 4 from rotating.

On the other hand, the development cartridge 4 is provided with first and second guides, which project from the left and right ends of the developing member (development roller) 305, in other words, the lengthwise ends of the development cartridge 4, in terms of the lengthwise direction of the development cartridge 4, one for one, as shown in Figures 4 and 5. Each of the first and second guides has a positioning

boss 310c, which is arcuate in cross section, and a flat guide rib 310b. The boss 310c fits in one of the cartridge positioning groove 400h, and corresponding receptacle 400d, of the rotary disc 400 (400A and 400B). The guide rib 310b fits in one of the guiding grooves 400b of the rotary disc 400 (400A and 400B).

Further, the development cartridge 4 is provided with a pair of projections 310m, which fit into the corresponding receptacles 400e of the rotary discs 400 (400A and 400B) to prevent the development cartridge 4 from rotating and also to precisely position the development cartridge 4 relative to the rotary. The guide rib 310b is provided with a member with an electrical contact 311A for development bias. The electric contact point 311 of the electrical contact 311A, which is to be electrically connected to the electrical contact point 410 (Figure 17), on the main assembly side, for the development bias, is exposed from one of the lengthwise ends of the development cartridge, that is, from the guide rib 310b, more specifically, at least from the top surface of the guide rib 310b, which constitutes one of the endmost surfaces of the development cartridge 4 in terms of the lengthwise direction of the cartridge 4.

Referring Figure 13, the rotary discs 400

(400A and 400B) are provided with a spring 53 for keeping the development cartridge 4 pressured toward the counterclockwise direction of the drawing. The spring 53 is partially in the guiding groove 400b, and is in contact with the pressure catching portion 310k of the bottom portion of the guiding rib 310b. The development cartridge 4 is kept pressured in the direction to rotate about the boss 310c, by the resiliency of the spring 53 and the moment generated by the force for rotationally driving the development roller 305. The projections 310m of the development cartridge 4 are placed in contact with the receptacles 400e of the rotary discs 400 (400A and 400B), one for one, with no gap.

Referring to Figures 7, 11, 18, etc., the development cartridge 4 in this embodiment is provided with a development cartridge locking portion 300g. This cartridge locking portion 300g is allowed to freely move in the lengthwise direction of the development cartridge, in the long hole 310q formed in the lengthwise direction of the development cartridge 4 through the positioning boss 310c. Normally, it is under such pressure that keeps it projecting outward. As the operational button 310p of the handle H of the development cartridge is pushed into the handle H, the cartridge locking portion 300g is retracted into the development cartridge.

In other words, as the development cartridge 4 is inserted into the rotary 40, the cartridge locking portion 300g fits into the cartridge locking hole 400g in the cartridge positioning groove 400h of the rotary disc 400 (400A, 400B). As a result, the development cartridge 4 is reliably retained in the position in which the cartridge locking portion 300g fits into the locking hole 400g.

With the employment of the above described method for positioning the development cartridge 4, the development cartridge 4 does not become disengaged from the rotary while the rotary 40 is rotated. In order to remove the development cartridge 4 from the apparatus main assembly, the handle H located at the center of the top surface of the development cartridge 4 is to be grasped while pressing the operational button 310p inward of the handle H. With this action, the development cartridge 4 can be pulled out, upward from the rotary 40 as shown in Figure 11.

As described above, the development cartridge 4 is held between the two rotary discs 400 (400A and 400B) of the rotary 40, by the springs 53, cartridge locking portions 300g, etc., so that the development cartridge 4 can be easily mounted or dismounted. Thus, the development cartridge 4 can be easily mounted into, or dismounted from, the rotary 40, in other words, the main assembly of an image forming

apparatus, through a simple operation carried out by a user.

(Structures for Driving Rotary and Development Cartridge)

Next, referring to Figures 14 - 17, the structures for driving the rotary 40 and development cartridge 4 will be described.

Each of the rotary discs 400 (400A and 400B) is provided with a rotary supporting plate 450, which is on the outward side of the rotary disc 400. The central axis 51 of the rotary 40 is attached to the rotary discs 400 in such a manner that the central axis 51 penetrates both the rotary discs and rotary supporting plates 450. In other words, the rotary discs 400 and central axis 51 are rotatably supported by the pair of rotary supporting plates 450.

Next, referring Figures 11 and 14, the peripheral portion of each of the rotary discs 400 (400A and 400B) of the rotary 40 constitutes a gear 308. The two gear portions 308 are meshed with a pair of follower gears, one for one, located at the lengthwise ends of the rotary 40, although the follower gears are not shown. The two follower gears are connected by a rotational axis. Thus, as one of the rotary discs 400, for example, the rotary disc 400A, rotates, the other rotary disc, or the rotary disc 400B, is rotated in synchronism with the rotary

disc 400A, by the follower gears. The gear portion 308 of one of the rotary discs, which in this embodiment is the gear portion 308 of the rotary disc 400B, is connected to a rotary driving motor (unshown).

With the provision of the above described structure for driving the rotary, the problem that one of the rotary discs 400 (400A and 400B) is twisted while the rotary discs 400 (400A and 400B) are rotated, or while the development roller is driven, is prevented.

Referring to Figures 14 and 16, one of the rotary supporting plates 450, which in this embodiment is the rotary supporting plate 450 for the rotary disc 400B, is provided with a plurality of gears 55 (55a, 55b, 55c, 55d, and 55e). The input gear 307 of the development cartridge 4 is meshed with the most downstream gear 55e of the gear train (driving force transmission gear trains) attached to the rotary supporting plate 450, and rotationally drives the development roller 305, coating roller 304, stirring member 303, etc.

In this embodiment, as the rotary discs 400 rotate, the development cartridge 4 orbitally moves a predetermined angle about the rotational axes of the rotary discs 400, causing its input gear 307 to mesh with the most downstream gear 55e of the gear train

attached to the rotary supporting plate 450.

Next, referring to Figure 15, as the development cartridge 4 is orbitally moved in the direction indicated by an arrow mark R to the development position by the rotation of the rotary 40, the most downstream gear 55e of the gear train attached to the rotary supporting plate 450 meshes with the input gear 307 of the development cartridge 4.

As the input gear 307 of the development cartridge 4 is driven by the most downstream gear 55e of the rotary supporting plate 450, it is subjected to a force F directed as indicated by an arrow mark in Figure 16. This force F (moment) acts in the direction to rotate the development cartridge 4 held in the grooves 400d of the rotary discs 400, about the positioning bosses 310c of the development cartridge 4, in the counterclockwise direction of the drawing. As a result, the projections 310m of the development cartridge 4 are kept pressed upon the V-shaped receptacles 400e of the rotary discs 400, preventing thereby the development cartridge 4 from moving out of the predetermined development cartridge position in the rotary 40 while the development cartridge 4 is driven in the development position. This force F is a part of the closed dynamical system within the rotary. Therefore, it has little effect upon the pressure W

(Figure 15) applied to the photoconductive drum 1 by the development cartridge 4.

The above described process for positioning the development cartridge can occur at both rotary discs 400 (400A and 400B) at the same time.

In this embodiment, however, the cartridge positioning process which is to occur on the rotary disc 400B side is made different from that on the rotary disc 400A side.

More specifically, referring to Figure 5, the size (diameter) of the positioning boss 310c on the rotary disc 400B side of the development cartridge 4 is made smaller than that of the positioning receptacle 400d of the rotary disc 400B in order to provide a predetermined amount of gap between the two. However, the positioning boss 310c is provided with a rib 310s, which projects from a part of the peripheral surface of the positioning boss 310c so that it contacts the inward surface of the positioning receptacle 400d.

With the provision of the above described structural arrangement, the positioning boss 310c of the development cartridge, on the rotary disc 400A side, precisely fits in the positioning boss holding receptacle 400d of the rotary disc 400A, and the projection 310m of the development cartridge contacts the V-shaped receptacle 400e of the rotary disc 400A.

As a result, the development cartridge 4 is highly precisely positioned.

On the other hand, on the rotary disc 400B side, the positioning boss 310c of the development cartridge loosely fits in the positioning boss holding receptacle 400d of the rotary disc 400B. However, as the development cartridge 4 begins to be driven by being moved to the development position, the development cartridge 4 is subjected to such force that presses the development cartridge 4 in the direction of the arrow mark. As a result, the projection 310m of the development cartridge fits into the V-shaped receptacle 400e of the rotary disc 400A. In addition, the rib 310s projecting from a part of the peripheral surface of the positioning boss 310c comes into contact with the inward surface of the positioning boss holding receptacle 400d. Therefore, the development cartridge 4 is accurately placed in the predetermined position.

Also in this embodiment, the development cartridge 4 is precisely positioned relative to the main assembly, more specifically, the rotary 40, of an image forming apparatus, by being moved to the development position.

(Method for Mounting Development Cartridge into Image Forming Apparatus)

Next, the structures of the guide ribs 310b

of the development cartridge 4, and the structure of the electrical contact of the development cartridge 4 for development bias, will be described.

Referring to Figures 4 - 10, in this embodiment, the lengthwise ends of the main structure of the development cartridge 4 are covered with side covers 310 (310A and 310B), one for one, which are separable from the main assembly of the development cartridge 4. Figure 8 shows the development cartridge 4, the side cover 310A, that is, the left side cover in the drawing, which has been separated from the main assembly of the development cartridge.

Referring to Figures 8 - 10, the side cover 310A is attached to the development cartridge main assembly in the following manner: First, the positioning hole 300c of the development cartridge main assembly (which hereinafter may be referred to "cartridge frame") is to be aligned with the positioning boss 310d1 of the side cover 310. Then, screws 330 and 331 are to be put through the holes 310e and 310f of the side cover 310A, and then, are to be screwed into the holes 300e and 300f of the development cartridge main assembly, respectively. The side cover 310B is attached to the development cartridge main assembly also with screws in the same manner as the side cover 310A.

The development cartridge 4 is provided with

the positioning bosses 310c for positioning the development cartridge 4, and guide ribs 310b for guiding the development cartridge 4. More specifically, each of the side covers 310 (310A and 310B) located at the lengthwise ends of the development cartridge main assembly, one for one, is provided with the positioning boss 310c and guide rib 310b. Thus, as the positioning bosses 310c and guide ribs 310b of the development cartridge 4 are inserted into the corresponding cartridge positioning grooves 400h, positioning boss holding receptacles 400d, guiding grooves 400b, etc., of the rotary discs 400 (400A and 400B), the development cartridge 4 is disposed in the predetermined position relative to the rotary discs 400 (400A and 400B), in other words, it is precisely disposed in the image forming apparatus main assembly.

The side cover 310A of the development cartridge 4 is provided with the electrical contact 311A for development bias, the contact point 311 of which is exposed from the top surface of the guide rib 310b. As the development cartridge 4 is fixed in position by being moved into the development position, the electrical contact point 311 for the development bias, which will be described later in detail, becomes electrically connected to the electrical contact point 410 (Figure 19) for the development bias, on the

apparatus main assembly side.

Referring to Figure 10, in this embodiment, the development bias electrical contact 311A having the development bias contact point 311 is wired so that as the side cover 310A is attached to the development cartridge main assembly, the development bias electrical contact 311A becomes connected to the developing member (development roller) 305 and developer coating member (toner supplying roller) 304 of the development cartridge 4. With this structural arrangement, it is possible to apply both the development bias and coating member bias to the development roller 305 and toner supplying roller 304, respectively.

The development bias contact point 311 is disposed on the guide rib 310b. Therefore, as the development cartridge is mounted into the rotary 40, the contact point 311 is moved in the direction parallel to the direction in which the development cartridge is mounted. Further, the guide rib 310b is such a portion of the development cartridge 4 that guides the development cartridge 4 by being fitted in the cartridge guiding groove 400b of the rotary disc 400, and the contact point 311 is exposed from the top surface of the guide rib 310b. Therefore, the contact point 311 is guided in the same manner as the guide rib 310b, assuring that the contact point 311 is

precisely placed in a position in which it allows the development bias to be applied from the image forming apparatus main assembly.

Next, referring to Figures 4 and 18, the development cartridge 4 has a first projection 310h and a second projection 310a. The first projection 310h is butted against the development bias electrical contact side of the image forming apparatus main assembly, in order to accurately position the development cartridge main assembly in terms of its lengthwise direction, and the second projection 310a is for regulating the movement of the development cartridge 4 in the direction opposite to the direction in which the development cartridge 4 is butted against the development bias electrical contact side of the image forming apparatus main assembly. These structural arrangements and the operations thereof will be described later.

Next, referring to Figures 11 and 12, the rotary 40 and rotary discs 400 (400A and 400B) will be further described.

Figure 11 shows how one of the development cartridges 4 is inserted into the rotary 40, and Figure 12 shows the details of the rotary disc 400A, that is, the rotary disc 400 on the side from which the rotary 40 is not driven.

Referring to Figure 12, the rotary disc 400A,

on the side from which the rotary 40 is not driven, has: a cartridge positioning groove 400h for assuring that the development bias electrical contact of the development cartridge 4 is placed in contact with the development bias electrical contact on the apparatus main assembly side; a positioning boss holding receptacle 400d for supporting the positioning boss 310c of the development cartridge 4; a groove 400a for regulating the movement of the development cartridge 4 in the direction opposite to the direct in which the development cartridge is butted against the development bias electrical contact side of the rotary 40; a guiding groove 400b, a hole 400c for allowing the development bias electrical contact 410 on the apparatus main assembly side to make contact with the development bias electrical contact on the development cartridge side; and a hole 400g into which a development cartridge position locking portion of the development cartridge 4 fits.

Referring to Figure 11, the development cartridge 4 is to be inserted into the rotary 40 with the guide portions 310b on the lengthwise ends of the development cartridge 4 aligned with the guiding grooves 400b, one for one. After the insertion, the rotary 40 is rotated so that the development cartridge 4 is moved to the location at which it comes into contact with the electrical contact point 410 attached

to the supporting plate 450 of the rotary 40 shown in Figure 17.

Figure 15 shows the development cartridge 4 which has been locked into the predetermined position, that is, the development position.

While being kept in the above described state, the development cartridge 4 is driven by the driving force from the image forming apparatus main assembly. As a result, the first projection 310h of the development cartridge 4 comes into contact with the cartridge positioning groove 400h of the rotary 40, securing a predetermined distance between the development bias electrical contact point 410 of the apparatus main assembly and the development cartridge 4, as shown in Figures 18 and 19.

In other words, as the development cartridge 4 is moved into the development position, the driving gear 55e on the apparatus main assembly side engages with the driving gear 307 of the development cartridge 4, as shown in Figure 15. As a result, the driving force is transmitted from the driving force input gear 307 to the development roller driving gear 305a through an idler gear 307a integral with the driving force input gear 307, as shown in Figure 4.

In this embodiment, the driving force input gear 307, idler gear 307a, and development roller driving gear 305a are helical gears, and the driving

force input gear 307 is driven. With the provision of the above described structural arrangement, as the driving force is transmitted to the driving force input gear 307, the development roller 305 and development cartridge 4 are pressed leftward in terms of the lengthwise direction of the development cartridge 4 in Figures 4 and 11. As a result, the first projection 310h of the development cartridge 4 comes into contact with the cartridge positioning groove 400h of the rotary 40, as shown in Figure 19.

As for the movement of the development cartridge 4 in the opposite direction (rightward in Figures 4 and 11) in terms of its lengthwise direction, the end surface of the second projection 310a attached to the development cartridge 4 makes contact with the bottom surface of the groove 400a of the rotary disc 400 of the image forming apparatus main assembly, regulating thereby the movement of the development cartridge in the aforementioned opposite direction in terms of its lengthwise direction.

In other words, the member 310a is provided for regulating the movement of the development cartridge 4 in the opposite direction even if the projection 310h of the development cartridge 4 fails to satisfactorily come into contact with the contact portion of the cartridge positioning groove 400h of the rotary 40 due to irregularities in the driving of

the development cartridge 4. Therefore, the fluctuation of the distance between the development bias electrical contact point 410 of the image forming apparatus main assembly and the development bias electrical contact point 311 of the development cartridge 4 can be minimized.

In this embodiment, the development bias electrical contact point 410 is in the form of a coil spring, and is fixed to the supporting plate 450 of the rotary 40, as shown in detail in Figures 17 and 19. As the development cartridge 4 is moved to the predetermined position, the development bias electrical contact point 311 comes into contact with the development bias electrical contact point 410.

The development bias electrical contact point 311 is attached to the guide rib 310b on the side from which the development cartridge 4 is not driven, and the first projection 310h for positioning the development cartridge 4, the boss 310c, and the guide rib 310b are integral. Therefore, the error in the distance between the first projection 310h for positioning the development cartridge 4 in terms of its lengthwise direction, and the development bias electrical contact point 311, can be reduced to the error in the position of a single component resulting from the tolerance for the single component.

Further, as for the positional relationship

between the development bias electrical contact point 410 of the image forming apparatus main assembly and the development bias electrical contact point 311 of the development cartridge 4, there are only the rotary supporting plate 450, development bias electrical contact point 410, rotary 40, and the contact point 311 of the development cartridge 4, listing from the outward side of the rotary 40.

In other words, the number of the components between the development bias electrical contact point 410 of the image forming apparatus main assembly and the development bias electrical contact point 311 of the development cartridge 4 is substantially smaller compared to that in accordance with the prior arts; the overall error resulting from the sum of the tolerances of the components between the two development bias electrical contact points 410 and 311 can be minimized. In addition, the above described structural arrangement makes it easier to keep the predetermined distance between the two contact points. Therefore, the development bias can be reliably applied.

Further, the positioning of the development cartridge 4 in terms of its lengthwise direction, and the application of the development bias, are done on the rotary disc 400A side, that is, the rotary disc on the side from which the development cartridge 4 is not

driven, in other words, on the side opposite to the driving force input portion having the driving force input gear 307. Therefore, the distance between the development bias electrical contact point 410 of the image forming apparatus main assembly and the development bias electrical contact point 311 of the development cartridge 4 is less likely to be affected by the minute displacement of the development cartridge 4 in its widthwise direction caused by the driving force; it is easier to keep the development bias electrical contact point 410 of the image forming apparatus main assembly and the development bias electrical contact point 311 of the development cartridge 4 at the predetermined locations. Therefore, it is possible to reliably apply the development bias.

Referring to Figure 9, the electrical contact point 311 of the development cartridge 4 mounted in an electrophotographic image forming apparatus equipped with the rotary type developing apparatus 4A is disposed on the guide rib 310b which is raised from the surfaces 310i and 310j. Further, such a structural arrangement is made that the resinous portions of the development cartridge 4 neither intersect with the orbital path of the development bias electrical contact point 311 of the development cartridge 4 while the rotary 40 is rotated, nor are

they as high, from the surfaces 310i and 310j, as the development bias electrical contact point 311. With the provision of this structural arrangement, the bias voltage can be applied without damaging the resinous portion of the development cartridge 4. Further, referring to Figure 18, the top surface of the guide rib 310b is recessed inward of the development cartridge 4 by a distance E from the end surface of the projection 310h for regulating the position of the development cartridge 4 in terms of its lengthwise direction.

Also with the provision of the above described structural arrangement, it is unnecessary to provide the surfaces 310i and 310j of the development cartridge 4 with a portion, in addition to the guide rib 310b, higher than the surfaces 310i and 310j, in order to attach the development bias electrical contact point 311. Therefore, it is possible to save space. Further, the surfaces 310i and 310j have nothing which hangs up when inserting the development cartridge. Therefore, the development cartridge can be smoothly inserted, improving the development cartridge in terms of the efficiency with which the development cartridge is mounted or dismounted.

As described above, in this embodiment, the development cartridge 4 is provided with the second projection for regulating the movement of the

development cartridge 4 in the direction opposite to the location of the first projection 310h for positioning the development cartridge 4 in terms of its lengthwise direction, whereas the rotary 40 of the image forming apparatus main assembly is provided with the regulation groove 400a for regulating the movement of the development cartridge 4 in the direction opposite to the cartridge positioning groove 400h. With the provision of this structural arrangement, it is easier to keep constant the distance between the development bias electrical contact point 410 and development bias electrical contact point 311, making it possible to reliably apply the development bias voltage.

Also in this embodiment, the position of the development cartridge 4 in terms of its lengthwise direction, and the application of the development bias, are accomplished from the side from which the development cartridge 4 is not driven, that is, from the side apart from the portion of the development cartridge 4 through which the driving force is inputted into the development cartridge 4. Therefore, the positioning of the development cartridge 4 and application of the development bias are less likely to be affected by the displacement of the development cartridge 4 in the widthwise direction of the development cartridge 4 by the driving force, making

it possible to reliably apply the development bias.

Also in this embodiment, the development bias electrical contact point 311 is attached to the guide rib 310b of the development cartridge 4. Therefore, the resinous portion of the development cartridge 4 in the adjacencies of the electrical contact point 311 is not damaged when the rotary 40 is rotated. Therefore, it is unnecessary to set up the development bias electrical contact point 311 one step higher than the surfaces 310i and 310j of the development cartridge 4; it is possible to reduce the development cartridge 4 in size. Also with the above described structural arrangement, the development cartridge 4 has no portion which hangs up when mounting or dismounting the development cartridge 4. Therefore, it is possible to smoothly mount or dismount the development cartridge 4, improving the efficiency with the development cartridge 4 is operated by a user.

(Embodiment 2)

Figures 20 - 23 show the second embodiment of a development cartridge 4 in accordance with the present invention.

The general structure of the development cartridge 4 in this embodiment is the same as that in the first embodiment, except that in this embodiment, a pair of development bias contacts 311A and 312A are attached to the guide rib 310b on one of the

lengthwise end surfaces of the development cartridge 4. Thus, the components, members, etc., in this embodiment, which are similar in structure and function to those in the first embodiment described above, are given the same referential numbers as those given in the first embodiment, and their detailed descriptions will not be given.

In other words, also in this embodiment, the lengthwise end surface, on the side from which the development cartridge 4 is not driven, of the development cartridge 4, that is, the outward surface of the side cover 310A, is provided with: the first projection 310h for positioning the development cartridge 4 in its lengthwise direction; cartridge positioning boss 310c; second projection 310a for regulating the movement of the development cartridge 4 in the direction opposite to the direction in which the development cartridge 4 is pressed in terms of its lengthwise direction; and guide rib 310b for guiding the development cartridge 4 to the predetermined position when inserting the development cartridge 4, as in the first embodiment. In this embodiment, however, the guide rib 310b is provided with the pair of development bias electrical contacts 311A and 312A, which are disposed so that the development bias electrical contact points 311 and 312 are exposed at least from the top surface of the guide rib 310b.

These development bias electrical contact points 311 and 312 are electrically connected to the development bias electrical contact points 410 and 411 (Figure 23) of the image forming apparatus main assembly, as the development cartridge 4 is moved into the development position.

Referring to Figure 22, in this embodiment, the development bias electrical contact 311A having the development bias electrical contact point 311 is wired so that as the side cover 310A is attached to the development cartridge main assembly, the development bias electrical contact 311A becomes connected to the developing member (development roller) 305 and developer coating member (toner supplying roller) 304 of the development cartridge 4. With this structural arrangement, it is possible to apply the development bias and coating member bias to the development roller 305 and toner supplying roller 304, respectively. The development bias electrical contact 312A having the development bias electrical contact point 312 is wired so that as the side cover 310A is attached to the development cartridge main assembly, the development bias electrical contact 312A becomes electrically connected to the developer amount regulating member (development blade) 332 of the development cartridge 4. With this structural arrangement, it is possible to apply the developer

amount regulating bias voltage to the development blade 332.

The structure of the lengthwise end surface, on the side from which the development cartridge 4 is driven, of the development cartridge 4, that is, the outward surface of the side cover 310B, is the same as that in the first embodiment shown in Figure 5.

In order to assure that the development cartridge 4 is mounted in the predetermined position, the end guide 310b1 is given a length equal to approximately half the radius of the arcuate surface of the development cartridge 4. In other words, the end guide 310b1 is long enough for a plurality of electrical contact points to be attached to the end guide 310b1. Therefore, the plurality of electrical contact points can be attached to the end guide 310b1 so that all of the plurality of electrical contact points are positioned at the same level. Therefore, it is possible to keep the contact pressure stable.

The operation for inserting the development cartridge 4 in this embodiment into the rotary 40 is the same as that for inserting the development cartridge 4 in the first embodiment into the rotary 40.

Next, referring to Figure 15 which is a sectional view of the development cartridge 4 having

been locked into the predetermined position, as the development cartridge 4 is driven by the force from the image forming apparatus main assembly, the first projection 310h of the development cartridge 4 comes into contact with the cartridge positioning groove 400h of the rotary 40. As a result, a predetermined distance is secured between the development bias electrical contact points 410 and 411 of the image forming apparatus main assembly and the development cartridge 4.

On the other hand, the lengthwise movement of the development cartridge 4 in the direction opposite to the direction in which the development cartridge 4 is pressed as the development cartridge 4 is driven is regulated as the end surface of the second projection 310a attached to the development cartridge 4 comes into contact with the bottom surface of the development cartridge movement regulating groove 400a of the rotary disc 400 of the image forming apparatus main assembly.

In other words, also in this embodiment, the member 400a for regulating the movement of the development cartridge 4 in the direction opposite to the direction in which the development cartridge 4 is pressed as the development cartridge 4 is driven, is provided for regulating the movement of the development cartridge 4 when the first projection 310h

of the development cartridge 4 fails to satisfactorily come into contact with the cartridge positioning groove 400h of the rotary 40 because of irregularities in the driving of the development cartridge 4. Therefore, the fluctuation of the distances between the development bias electrical contact points 410 and 411 of the image forming apparatus main assembly and the development bias electrical contact points 311 and 312, respectively, of the development cartridge 4 can be reduced.

Further, the two development bias electrical contact points 410 and 411 of the image forming apparatus main assembly, more specifically, the supporting plate 450 of the rotary 40 are in the form of a coil spring, and the contacts 410 and 411 are fixed to the supporting plate 450 of the rotary 40.

To these two development bias electrical contact points 410 and 411 of the image forming apparatus main assembly, the development bias electrical contact points 311 and 312 of the development cartridge 4 are electrically connected.

The development bias electrical contact points 311 and 312 are attached to the end guide 310b2 on the side from which the development cartridge 4 is not driven, at the same heights from the base of the guide 310b2. Therefore, the error in the distances between the positioning projection 310h and the

contact points 311 and 312 can be limited to the variations in the position of a single component resulting from the tolerance of the single component.

The positional relationships between the development bias electrical contact points 410 and 411 and development bias electrical contact points 311 and 312, respectively, are as follows: there are only the rotary supporting plate 450, development bias electrical contact point 410, rotary 40, and the contact point 311 of the development cartridge 4, listing from the outward side of the rotary 40.

Therefore, the number of the components between the pair of development bias electrical contact points 410 and 411 and the pair of development bias electrical contact points 311 and 312 is substantially smaller compared to that in accordance with the prior arts; the overall error in positional relationship resulting from the sum of the tolerances of the components between the pair of development bias electrical contact points 410 and 411 and the pair of development bias electrical contact points 311 and 312, respectively, can be minimized. Therefore, it is easier to keep a predetermined distance between the two pairs of contact points. Therefore, the development bias can be reliably applied.

Further, the positioning of the development cartridge 4 in terms of its lengthwise direction, and

the application of the development bias, are accomplished on the rotary disc 400A side, that is, the side apart from the driving force input portion having the rotary disc on the side from which the development cartridge 4 is not driven, in other words, on the side opposite to the driving force input portion having the driving force input gear 307. Therefore, the distances between the pair of development bias electrical contact points 410 and 411 and the pair of development bias electrical contact points 311 and 312, respectively, are less likely to be affected by the minute displacement of the development cartridge 4 in its widthwise direction caused by the driving force; it is easier to keep the pair of development bias electrical contact points 410 and 411 and the pair of development bias electrical contact points 311 and 312 at the predetermined locations. Therefore, it is possible to reliably apply the development bias.

Further, in order to prevent the resinous portion of the development cartridge 4 in the adjacencies of the development bias electrical contact points 311 and 312 from being damaged, it is necessary to attach the development bias electrical contact points 311 and 312 to the portions of the development cartridge 4, which is raised from the surfaces 310i and 310j.

In this embodiment, therefore, the development bias electrical contact points 311 and 312 are attached to the top surface of the guide rib 310b, which is located more outward from the main assembly of the development cartridge 4, in terms of the lengthwise direction of the development cartridge 4, than the surfaces 310i and 310j. Therefore, it is possible to eliminate the need for providing the surfaces 310i or 310j of the development cartridge 4 with an additional raised portion to which the development bias electrical contact points 311 and 312 are to be attached, contributing thereby to space saving. Further, without the additional raised portion on the surface 310i and/or 310j, the surfaces 310i and 310j do not have such a portion that hangs up during the insertion of the development cartridge, making it possible to smoothly insert the development cartridge, improving in turn the efficiency and ease with which the development cartridge is mounted or dismounted by a user.

As described above, in this embodiment, the development cartridge 4 is provided with the positioning rib, whereas the rotary 40 of the image forming apparatus main assembly is provided with the groove for positioning the development cartridge 4 in terms of the lengthwise direction of the development cartridge 4. Therefore, it can be made

easier to keep constant the distances between the pair of development bias electrical contact points 410 and 411 and the pair of development bias electrical contact points 311 and 312, respectively. Therefore, the development bias can be reliably applied.

Also in this embodiment, the positioning of the development cartridge 4 in terms of its lengthwise direction, and the application of the development bias, are accomplished from the side from which the development cartridge 4 is not driven, that is, from the side apart from the portion of the development cartridge 4 through which the driving force is inputted into the development cartridge 4. Therefore, the positioning of the development cartridge 4 and application of the development bias are less likely to be affected by the displacement of the development cartridge 4 in the widthwise direction of the development cartridge 4 by the driving force, making it possible to reliably apply the development bias. Further, this embodiment makes it possible to dispose a plurality of development bias electrical contact points on the guide rib 310b, at the same heights from the surface from which the guide rib 310b projects. Therefore, it is possible to equalize the plurality of development bias electrical contact points in terms of the pressure applied thereto, making it possible to reliably apply stable development bias.

Also in this embodiment, the development bias electrical contact points 311 and 312 are attached to the guide rib 310b of the development cartridge 4. Therefore, the resinous portions of the development cartridge 4 in the adjacencies of the electrical contact points are not damaged when the rotary 40 is rotated. Therefore, it is unnecessary to set up the development bias electrical contact points one step higher than the adjacencies of the contact points; it is possible to reduce the development cartridge 4 in size. Also with the above described structural arrangement, the development cartridge 4 does not have such a projecting portion that hangs up when mounting or dismounting the development cartridge 4. Therefore, it is possible to smoothly mount or dismount the development cartridge 4, improving the efficiency with the development cartridge 4 is operated by a user.

Referring to Figures 4 and 20, as is understandable from the above descriptions, according to the first and second embodiments of the present invention, the development cartridges 4 are provided with the positioning ribs, each of which is an integral combination of the guide rib 310b and positioning projection 310h. Further, the portion 310a of the development cartridge 4 for regulating the position of the development cartridge 4 in terms

of the lengthwise direction of the development cartridge 4 is on the imaginary extension of the positional rib. In other words, the positioning portion 310h, the guiding portion 310b, and the portion 310a for regulating the position of the development cartridge 4 in terms of the lengthwise direction are in alignment.

Therefore, it is possible to precisely position the positioning portion 310h, the electrical contacts on the guide rib 310b, and the portion310a for regulating the position of the development cartridge 4 in terms of its lengthwise direction, relative to the image forming apparatus main assembly. In other words, the electrical contacts can be precisely positioned in the image forming apparatus, making it possible to reliably supply the development cartridge 4 with stable bias.

Also in the first and second embodiments, the positioning portion 310c having the cartridge positioning portion 310h shown Figures 4 and 20 functions as the axle, about which the development cartridge 4 pivots. Further, when the development cartridge in the rotary 40 is moved to the development position, the electrical contact point 311 (312) is not excessively pressed upon the electrical contact point 410 (411) fixed to the inward side of the image forming apparatus main assembly, and therefore, can be

smoothly moved into the position in which the bias is supplied. Further, while the development cartridge 4 is moved into the development position, the pressure catching portion 310k of the guide rib 310b comes under the pressure generated by the resiliency of the spring 53 attached to the rotary and the pressure generated by the rotational moment generated as the development roller 305 is rotationally driven, and the projection 310m is pressed upon the surface of the receptacle 400e shown in Figure 13. As a result, the development cartridge 4 regains its development attitude, in which the electrical contact point 311 (312) on the guide rib 310b is positioned to supply the bias.

Further, the electrical contact point 311 (312) is disposed on the guide rib 310, and the positioning projection 310c, which is aligned with the electrical contact point 311 (312) virtually in the radial direction of the rotary 40, functions as the axle about which the positioning projection 310c pivots. Further, the pressure catching portion 310k of the guide rib 310b is under the pressure generated by the resiliency of the spring 53, and the development cartridge 4 receives the rotational moment generated as the development roller 305 is rotationally driven. Therefore, it is assured that the electrical contact point 311 (312) remains

accurately positioned even after the development cartridge 4 is moved to the development position.

Moreover, the cartridge 4 can be pivoted, making it possible to keep the electrical contact point 311 (312) apart from the electrical contact points 410 (411) of the image forming apparatus main assembly, or keep smaller the contact pressure between the electrical contact point 311 (312) and the electrical contact point 410 (411), until the last moment of the positioning of the development cartridge 4. Therefore, it is possible to reduce the amount by which the electrical contact point 410 (411) of the image forming apparatus main assembly and the electrical contact point 311 (312) are shaved by each other due to the friction caused by the contact pressure.

Next, referring to Figures 24 - 26, the structural arrangement and method for attaching a bearing member 340B and a side cover 310B to the cartridge frame 300 will be described.

Figure 24 shows one of the lengthwise ends of the cartridge frame 300; Figure 24 is a perspective view of one of the lengthwise ends of the cartridge frame 300, immediately prior to the attachment of the bearing member 340B to one of the lengthwise ends of the cartridge frame 300, or immediately after the removal of the bearing member 340B from the same

lengthwise end of the cartridge frame 300. Figure 25 is a perspective view of the same lengthwise end of the cartridge frame 300 as the one shown in Figure 24, to which the bearing member 340B has been attached, and to which the side cover 310B is ready to be attached, or from which the side cover 310B has just been removed. Figure 26 is a schematic drawing for showing how the bearing member 340B and side cover 310B are attached to, or removed from, the cartridge frame 300.

First, referring to Figure 24, the method for attaching the bearing member 340B to the cartridge frame 300 will be described.

The lengthwise end of the cartridge frame 300 shown in Figure 24 is provided with a groove 300cc and a projection 300dd, which are on the top and bottom sides of the lengthwise end. The lengthwise end is also provided with screw holes 300ee, 300ff, and 300hh. Designated by referential numbers 305c and 304a are one end of the shaft of the development roller 305, and one end of the shaft of the toner supply roller 304, respectively.

The bearing member 340B is provided with a bearing member cylinder 340aa, which projects from the inward surface a of the bearing member 340B, that is, the surface facing the cartridge frame 300. It is also provided with a hole 340bb. Further, it is

provided with a hole 340B1 in which the aforementioned end 305c of the shaft of the development roller 305 is rotationally supported, and a hole 340B2 in which the aforementioned end 304a of the shaft of the toner supply roller 304 is rotationally supported. Further, it is provided with a first projection 340dd and a second projection 340cc, which project from the outward surface b of the bearing member 340B, that is, the surface opposite to the aforementioned surface a. The second projection 340cc supports a gear 307 (helical gear). As the development cartridge 4 is mounted into the image forming apparatus main assembly 100, the gear 307 meshes with a gear (unshown) provided on the image forming apparatus main assembly 100 side, and receives the force for driving the development cartridge 4. The first projection 340 dd is provided with a screw hole 340dd1, which is in the end portion of the first projection 340dd.

Next, the side cover 310B, which is attached to one of the lengthwise ends of the cartridge frame 300 will be described.

The side cover 310B is provided with a projection 310aa, which projects from the inward surface a of the side cover B, that is, the surface which faces the cartridge frame 300. It also is provided with a cylinder 310hh, which projects from the inward surface a. Further, it is provided with a

first hole 310dd, a second hole 310cc, and a screw hole 310ee.

Next, the method for attaching the bearing member 340B to the cartridge frame 300 will be described.

First, the bearing member 340B is aligned with the cartridge frame 300 so that as the bearing member 340b is moved toward the cartridge frame 300, the peripheral surface of the cylinder 340aa makes contact with the inward surface of the groove 300cc, and the projection 300dd is put through the hole 340bb. Incidentally, the external diameter of the cylinder 340aa is virtually the same as the internal diameter of the groove 340aa. Thus, as the cylinder 340aa is fitted into the groove 300c, the position of the bearing member 340B relative to the cartridge frame 300 becomes fixed. Further, the hole 340bb is long and narrow. Therefore, it prevents the bearing member 340B from rotating about the cylinder 340aa; it is a so-called "rotation checker". The end 305a of the development roller shaft is supported by the bearing member 340B by being put through the hole 340B1, and one end 304a of the toner supply roller shaft is supported by the bearing member 340B by being put through the hole 340B2.

Next, the bearing member 340B is screwed to the cartridge frame 300 with screws 335 and 336. The

screw 335 is put through the screw hole 340hh, and is screwed into the screw hole 300hh. The screw 336 is put through the screw hole 340ff, and is screwed into the screw hole 300ff. As a result, the bearing member 340B is attached to the cartridge frame 300.

Next, referring to Figure 25, the method for attaching the side cover 310B to one of the lengthwise ends of the cartridge frame 300, to which the bearing member 340B has been attached, will be described.

First, the projection 310aa is to be placed in contact with the internal surface 340aa1 of the cylinder 340aa in the groove 300c, at the same time as the first projection 340dd is fitted into the first hole 310dd. The first hole 310dd is a hole in the end portion of the cylinder 310dd1, and the first projection 340dd is metallic and cylindrical. It fits into the cylinder 310dd1, and at the same time, the second projection 340cc fits into the second hole 310cc. The second projection 340cc is also metallic and cylindrical. The internal diameters of the hole 310dd and cylinder are virtually the same as the external diameter of the first projection 340dd. The internal diameter of the hole 310cc is virtually the same as the external diameter of the projection 340cc. However, the projection 310aa is loosely in contact with the internal surface of the cylinder 340aa. Thus, the positional relationship of the side cover

310B relative to the cartridge frame 300 is fixed by: the portion of the projection 340dd, and the portion of the cylinder 310dd1, which engage with each other; the portion of the projection 340dd and the portion of the hole 310dd, which engage with each other; and the portion of the projection 340cc, and the portion of the hole 310cc, which engage with each other. Further, as the contact between the projection 310aa and the internal surface 340aa1 of the cylinder 340aa prevents the side cover 310B from rotating. Incidentally, because the side cover 310B is formed of plastic, it is capable of deforming even if two adjacent portions of the side cover 310B are used to position the side cover 310B relative to the cartridge frame 300. This deforming ability of the side cover 310B is used to absorb the error in the distance between the hole 310cc and 310dd, which occurs during manufacture.

Next, the side cover 310B is attached to the cartridge frame 300 with screws 337 and 338. The screw 337 is put through the hole 310ee, and screwed into a screw hole 300ee. The screw 338 is screwed into the screw hole 340dd1 in the end of the metallic projection 340dd integral with the bearing member 340B.

Through the above described procedure, the side cover 340B is attached to the cartridge frame

300. The cylinder 310hh loosely fits in the projection 300d put through the hole 340bb.

Next, referring to Figures 27 - 29, the structural arrangement and method for attaching the bearing member 340A and side cover 310A to the other length end of the cartridge frame 300, will be described.

Figure 27 shows the other lengthwise end of the cartridge frame 300; Figure 27 is a perspective view of the other lengthwise end of the cartridge frame 300, immediately prior to the attachment of the bearing member 340A to the other lengthwise end of the cartridge frame 300, or after the removal the bearing member 340A from the same lengthwise end of the cartridge frame 300. Figure 28 is a perspective view of the same lengthwise end of the cartridge frame 300 as the one shown in Figure 27, to which the side cover 310A is ready to be attached after the bearing member 340A was attached, or from which the side cover 310A has just been removed. Figure 29 is a schematic drawing for showing how the bearing member 340A and side cover 310A are attached to, or removed from, the cartridge frame 300.

First, referring to Figure 27, the method for attaching the bearing member 340A to the cartridge frame 300 will be described.

The lengthwise end of the cartridge frame 300

shown in Figure 27 is provided with a groove 300c and a projection 300d, which are on the top and bottom sides of the lengthwise end. This lengthwise end is also provided with screw holes 300e, 300f, 300h, and 300n. Designated by referential numbers 305b and 304b are the other end of the shaft of the development roller 305, and the other end of the shaft of the toner supply roller 304, respectively.

The bearing member 340A is provided with a bearing member cylinder 340a, which projects from the inward surface a of the bearing member 340A, that is, the surface facing the cartridge frame 300. It is also provided with a hole 340b, screw holes 340f and 340h, a hole 340A1 in which the other end 305b of the aforementioned development roller shaft is rotationally supported, and a hole 340A2 in which the other end 304b of the toner supply roller shaft is rotationally supported. Further, it is provided with a screw hole 340h in which the screw 334 is put through, and a screw hole 340f in which the screw 336 is put through.

Next, the side cover 310A, or the side cover which is attached to the other lengthwise end of the cartridge frame 300, will be described.

The side cover 310A is provided with an end cover projection 310dd, which projects from the inward surface a of the side cover B, that is, the surface

which faces the cartridge frame 300. It also is provided with a cylinder 310d2, which projects from the inward surface a. Further, it is provided with a screw holes 310e, 310f, and 310n.

Next, the method for attaching the bearing member 340A to the cartridge frame 300 will be described.

Incidentally, the cartridge frame 300 is provided with a projection 300d.

First, the bearing member 340A is aligned with the cartridge frame 300 so that as the bearing member 340A is moved toward the cartridge frame 300, the peripheral surface of the cylinder 340a makes contact with the inward surface of the groove 300c, and also so that the projection 300d is put through the hole 340b. The external diameter of the cylinder 340a is virtually the same as the internal diameter of the groove 340c. Thus, as the cylinder 340a is fitted into the groove 300c, the position of the bearing 340A relative to the cartridge frame 300 becomes fixed. Further, the hole 340b is long and narrow. Therefore, it prevents the bearing member 340A from rotating about the cylinder 340a; it is a so-called "rotation checker". The other end 305b of the development roller shaft is supported by the bearing member 340A by being put through the hole 340A1, and the other end 304b of the toner supply roller shaft is supported by

the bearing member 340A by being put through the hole 340A2.

Next, the bearing member 340A is attached to the cartridge frame 300 with screw 334. The screw 334 is put through the screw hole 340h, and is screwed into the screw hole 300h. Through this procedure, the bearing member 340A is attached to the cartridge frame 300.

Next, referring to Figure 28, the method for attaching the side cover 310A to the other lengthwise end of the cartridge frame 300, to which the bearing member 340A has been attached, will be described.

First, the projection 310a is to be placed in contact with the internal surface 340a1 of the cylinder 340a in the groove 300c, and at the same time, the projection 340d is placed in contact with the internal surface of the cylinder 310b.

The external diameter of the projection 310d1 is virtually the same as the internal diameter of the cylinder 340a. Further, the internal hole of the cylinder 310d2 is long, and small in diameter, and the projection 300d loosely fits in the cylinder 310d2. Thus, the positional relationship between the side cover 310A relative to the cartridge frame 300 is fixed by the engagement between the projection 310d1 and the internal surface 340a1 of the cylinder 340a, and the side cover 310A is prevented from rotating by

the engagement between the projection 300d2 and the internal surface 310d21 of the cylinder 310d2.

Next, the side cover 310A is attached to the cartridge frame 300 with screws 330, 331 and 333. The screw 330 is put through the hole 310e, and screwed into a screw hole 300e. The screw 331 is screwed into the holes 310f, and 340f, and is screwed into the screw hole 300f of the cartridge frame 300. The screw 333 is put through the hole 340f, and is screwed into the screw hole 300n of the cartridge frame 300.

Through the above described procedure, the side cover 340A is attached to the cartridge frame 300.

The above described embodiments can be summarized as follows.

First, the development cartridge 4 removably mountable in the main assembly of an electrophotographic image forming apparatus comprises: the cartridge frame 300; development roller 305 for developing an electrostatic latent image formed on the electrophotographic photoconductive drum 1; groove 300cc with which one of the lengthwise ends of the cartridge frame 300 is provided; projection 300dd with which the same lengthwise end of the cartridge frame 300 as that with the groove 300c is provided; bearing member 340B which rotationally supports one end 305c of the shaft of the development roller 305 disposed in

parallel to the lengthwise direction of the cartridge frame 300; cylinder 340aa with which the bearing member 340B is provided, and which makes contact with the inward surface of the groove 300c; long and narrow hole 340bb with which the bearing member 340B is provided, and through which the projection 300d is put; metallic first projection 340dd provided on the outward surface of the bearing member 340B, that is, the surface opposite to the inward surface a provided with the cylinder 340aa; metallic second projection 340cc which is provided on the outward surface b, and supports the gear to which the driving force is transmitted from the image forming apparatus main assembly when the development cartridge 4 is in the image forming apparatus main assembly 100; first screws 335 and 336 for holding the bearing member 340B to the aforementioned lengthwise end of the cartridge frame 300; side cover 310B attached to the aforementioned lengthwise end of the cartridge frame 300 in a manner to cover the bearing member 340B; first hole 310dd with which the side cover 310B is provided, and into which the aforementioned first projection 340dd is fitted; second hole 310cc with which the side cover 310B is provided, and in which the aforementioned second projection 340cc is fitted; projection 310aa which is provided on the inward surface of the side cover 310B, and is in the hole

of the cylinder 340aa, being in contact with the internal surface a of the cylinder 340aa in the groove 300c; second screw 337 which holds the side cover 310B to one of the lengthwise ends of the cartridge frame 300; and third screw 338 which holds the side cover 310B to the first projection 340dd of the bearing member 340B.

The development cartridge 4 has the coating roller 304 for coating the developer on the development roller 305, and the bearing member 340B is provided with the hole 340B2 through which one end 304a of the shaft of the coating roller 304 projects outward.

The development cartridge 4 has the end guide 310b1 which is for guiding the development cartridge 4 when mounting the development cartridge 4 into the image forming apparatus main assembly 100, and which is on the outward surface b, that is, the surface opposite to the inward surface a on which the projection 310aa is provided.

The side cover 310B of the development cartridge 4 has a hole 310gg into which one end of a cartridge locking portion 300a is retractably inserted to prevent the development cartridge 4 from dislodging from the image forming apparatus main assembly 100 after the mounting of the development cartridge 4 into the image forming apparatus main assembly 100.

Further, the development cartridge 4 removably mountable in the main assembly of an electrophotographic image forming apparatus comprises: the cartridge frame 300; development roller 305 for developing an electrostatic latent image formed on the electrophotographic photoconductive drum 1; gear as a driving force receiving member 307 to which the driving force is transmitted from the image forming apparatus main assembly 100 when the development cartridge 4 is in the image forming apparatus main assembly 100; groove 300 with which the other lengthwise end of the cartridge frame 300 is provided; projection 300d with which the same lengthwise end of the cartridge frame 300 as that with the groove 300 is provided; bearing member 340A which rotationally supports the other end 305b of the shaft of the development roller 305 disposed in parallel to the lengthwise direction of the cartridge frame 300; cylinder 340a with which the bearing member 340A is provided, and which is placed in contact with the inward surface of the groove 300; long and narrow hole 340b with which the bearing member 340A is provided, and through which the projection 300d on the other side of the cartridge frame 300 is put; first screw 334 which holds the bearing member 340A to the other lengthwise end of the cartridge frame 300; side cover 310A attached to the aforementioned other lengthwise

end of the cartridge frame 300 in a manner to cover the bearing member 340A; projection 310d1 with which the side cover 310A is provided, and is placed in contact with the internal surface of the cylinder 340a of the bearing member 340A in contact with the inward surface of the groove 300c; cylinder 310d2 with which the side cover 310A is provided, and the internal surface of which is placed in contact with the projection 300d put through the hole 340 of the bearing member 340A; second screw 330 which holds the side cover 310A to the other lengthwise end of the cartridge frame 300; and third screw 331 which holds both the bearing member 340A and side cover 310A to the other lengthwise end of the cartridge frame 300.

The development cartridge 4 has the coating roller 304 for coating developer on the development roller, and the bearing member 340A is provided with the hole 340A2 through which the other end 304b of the shaft of the coating roller 304 projects outward. The bearing member 340A is also provided with a hole 340r through which a toner seal t is pulled out. The toner seal t keeps unsealably sealed the opening (unshown) with which the developer storage portion 303 is provided to release the developer in the developer storage portion 303.

The side cover 310A of the development

cartridge 4 has the guide 310b which is for guiding the development cartridge 4 when mounting the development cartridge 4 into the image forming apparatus main assembly 100, and which is on the outward surface b of the side cover 310A, that is, the surface opposite to the inward surface a on which the projection 310aa is provided. It also has a hole 3101 through which the toner seal t for keeping unsealably sealed the opening of the developer holding storage portion 302 is pulled out.

Further, the side cover 310A of the development cartridge 4 has a hole 310g into which one end of a cartridge locking member 300g is retractably inserted to prevent the development cartridge 4 from dislodging from the image forming apparatus main assembly 100 after the mounting of the development cartridge 4 into the image forming apparatus main assembly 100.

The method for attaching the side cover 310B to one end of the cartridge frame 300 comprises the following steps:

Shaft supporting step for rotationally supporting one end 305a of the shaft of the development roller 305, with the bearing member 340B; cylinder fitting step for fitting the cylinder 340aa of the bearing member 340b into the groove 300cc located in one of the lengthwise ends of the cartridge

frame 300, in order to attach the bearing member 340B to the cartridge frame 300; projection placing step for putting the projection 300dd with which the same lengthwise end of the cartridge frame 300 as that having the groove 300c is provided, through the hole 340bb of the bearing member 340B, in order to attach the bearing member 340b to the cartridge frame 300; screwing step for putting the screws 335 and 336 through the holes 340ff and 340hh, respectively, of the bearing member 340B, and screwing the screws 335 and 336 into the screw holes 300ff and 300hh, respectively, of the cartridge frame 300, in order to attach the bearing member 340B to the cartridge frame 300; side cover projection placing step for placing the projection 310aa of the side cover 340B in contact with the internal surface 340aa1 of the cylinder 340aa, in the groove 300cc of the cartridge frame 300, of the bearing member 340B; first fitting step for fitting the metallic first projection 340dd of the bearing member 340B into the first hole 310dd of the side cover 310B; second fitting step for fitting the metallic second projection 340cc of the bearing member 340B into the second hole 310cc of the side cover 310B; first screwing step for putting the screw 337 through the hole 310ee of the side cover 310B, and screwing the screw 337 into the screw hole 300ee of the cartridge frame 300, in order to attach the side

cover 310B to the cartridge frame 300 with the use of the screw 337; second screwing step for putting the screw 338 through the hole 310dd of the side cover 310B, and screwing the screw 338 into the screw hole 340dd1 of the first projection 340dd of the bearing member 340B, in order to attach the side cover 310B to the cartridge frame 300 with the use of the screw 338.

The method for attaching the side cover 310B also comprises: the shaft placing step for projecting outward the other end 304a of the shaft of the coating roller 304 for coating developer on the development roller 305, through the hole 340B2 of the bearing member 340B when attaching the bearing 340B to the cartridge frame 300.

Further, the method for attaching the side cover 310B comprises: the locking step for making one end of the cartridge locking portion 300g for preventing the development cartridge 4 from dislodging from the image forming apparatus main assembly 100, project outward through the locking hole 310gg of the side cover 310B when mounting the development cartridge 4 into the image forming apparatus main assembly 100.

In comparison, the method for attaching the side cover 310A, or the other side cover, to the other lengthwise end of the cartridge frame 300 comprises

the following steps:

Shaft supporting step for rotationally supporting the other end 305b of the shaft of the development roller 305, in terms of the lengthwise direction of the development roller 305, by the bearing member 340A, or the other bearing member; cylinder placing step for placing the cylinder 340a of the bearing member 340A, in the groove 300c located in the other lengthwise end of the cartridge frame 300, in order to attach the bearing member 340A to the other lengthwise end of the cartridge frame 300; projection placing step for putting the projection 300d of the other lengthwise end of the cartridge frame 300 through the hole 340b of the bearing member 340A, in order to attach the bearing member 340A to the cartridge frame 300; screwing step for putting the screw 334 through the hole 340b of the bearing member 340A, and screwing the screw 334 into the screw hole 300h of the cartridge frame 300, in order to attach the bearing member 340A to the cartridge frame 300 with the use of screw 334; projection placing step for placing the projection 310a of the side cover 310A in contact with the internal surface 340a1 of the cylinder 340a, in the groove 300c of the other lengthwise end of the cartridge frame 300, of the bearing member 310A; cylinder fitting step for fitting the cylinder 310b of the side cover 310A around the

projection 300d of the other lengthwise end of the cartridge frame 300, which has been put through the hole 340b of the bearing member 340A; first screwing step for putting the screw 333 through the hole 310h of the side cover 310A, and screwing into the screw hole 300h of the cartridge frame 300, in order to attach the side cover 310A to the cartridge frame 300 with the use of the screw 333; and second screwing step for putting the screw 331 through the holes 310f and 340f of the side cover 310A and bearing member 340A, respectively, and screwing the 331 into the screw hole 300f of the cartridge frame 300, in order to screw the side cover 310A to the cartridge frame 300 with the use of the screw 331.

The method for attaching the side cover 310A to the other lengthwise end of the cartridge frame 300 also comprises the shaft placing step for inserting the other end 304b of the shaft of the coating roller 304 for coating developer on the development roller 305, through the hole 340m of the bearing member 340A, from the inward side of the hole 340m, so that the other end 304b sticks out from the outward side of the hole 340m, when attaching the bearing member 340A to the cartridge frame 300.

It also comprises: the locking step for making the other end of the cartridge locking portion 300g for preventing the development cartridge 4 from

dislodging from the image forming apparatus main assembly 100, project outward through the locking hole 310g of the side cover 310A after the placement of the development cartridge 4 in the image forming apparatus main assembly 100; and the toner seal placing step for placing the toner seal t for keeping unsealably sealed the developer releasing opening (unshown) of the developer storage portion 302, which is holding developer, through the toner seal hole 3101, from the inward side of the toner seal hole 3101, so that the toner seal t sticks out from the outward side of the toner seal hole 3101.

Incidentally, the above described cartridge frame 300, bearing members 340A and 340B, and side covers 310A and 310B are made of plastic (for example, styrene). In comparison, the first and second projections 340cc and 340dd are made of metallic material.

The structure of a development cartridge does not need to be limited to those in the above described embodiments, that is, the structure in which the developing member, and the developer storage portion in which the developer used by the developing member for developing an electrostatic latent image, are integrated into a unit which can be removably mountable in the main assembly of an image forming apparatus. For example, a development cartridge does

not need to have a developer storage portion. Further, a development cartridge may integrally comprise other components, members, etc., than a developing member and a developer storage portion, in addition to the developing member and developer storage. A process cartridge means a cartridge in which an electrophotographic photoconductive member and a developing member are integrally disposed, and which can be removably mountable in the main assembly of an image forming apparatus.

According to the above described embodiments of the present invention, before attaching the side covers 310A and 310B to the cartridge frame 300, the bearing members 340A and 340B are attached to the cartridge frame 300, as described above, fixing thereby the positions of the development roller 305 and coating roller 304 relative to the cartridge frame 300. Also according to the above described embodiments, the bearing members 340A and 340B are screwed to the cartridge frame 300, making it possible to attach the bearing members 340A and 340B to the cartridge frame 300 before attaching the side covers 310A and 310B to the cartridge frame 300. In other words, before the side covers 310A and 310B are attached to the cartridge frame 300, the bearing members 340A and 340B will have been fixed to the cartridge frame 300, making it easier to attach the

side covers 310A and 310B to the cartridge frame 300.

Also according to the above described embodiments, the projection 310d1 perfectly fits into the hollow 340a1 of the hollow cylinder 340a, accurately positioning the bearing member 340A and side cover 310A relative to the cartridge frame 300. In other words, both the bearing member 340A and side cover 310A are positioned by the same projection, or the projection 310d1, increasing thereby the degree of accuracy with which the bearing member 340A and side cover 310A are positioned relative to the cartridge frame 300. Therefore, the degree of accuracy with which the side cover 310A is attached to the cartridge frame 300 is improved.

Also according to the above described embodiments, the bearing members 340A and 340B are screwed to the cartridge frame 300, increasing thereby the degree of solidness with which the bearing members are attached to the cartridge frame 300. In addition, the side covers 310A and 310B are directly screwed to the cartridge frame 300, increasing thereby the degree of solidness with which the side covers 310A and 310B are attached to the cartridge frame 300. Further, both the bearing member 340A and side cover 310A are screwed to the cartridge frame 300 with a single screw, that is, the same screw. This also adds to the solidness with which the side covers 310A is attached

to the cartridge frame 300.

Also according to the above described embodiments, the first projection 340dd and second projection 340cc are made of metallic material (for example, stainless steel). Moreover, the metallic projection 340dd is fitted in the hollow of the hollow cylinder 310dd, and the external surface of this hollow cylinder 310dd is placed in contact with the image forming apparatus main assembly 100.

Thus, as the side cover 310B is attached to the cartridge frame 300, the metallic projection 340dd doubles as a member for reinforcing the side cover 310B. Therefore, even though the position of the development cartridge 4 relative to the image forming apparatus main assembly 100 is fixed by a part of the side cover 310B, the side cover 310B is prevented from deforming, or the deformation of the side cover 310B is minimized. Therefore, the development cartridge 44 is positioned relative to the image forming apparatus main assembly 100 at a higher degree of accuracy.

Further, if an assembly line worker forgets to attach the bearing member 340A to the cartridge frame 300 during the assembly of a development cartridge 4, it becomes impossible to accurately position the side cover 310A relative to the cartridge frame 300. As a result, it is obvious to the

assembler that the assembler or someone else forgot to attach the bearing member 340A. This is because the position of the projection 310d1 must be fixed by the internal surface of the hollow cylinder 340a.

Also according to the above described embodiments, the position of the adjacencies of the positioning portion 310dd1 of the side cover 310B, for positioning the side cover 310B relative to the image forming apparatus main assembly 100, is fixed by the metallic shaft 340dd, and the side cover 310B is screwed to the cartridge frame 300. Further, the metallic shaft 340cc is in the adjacencies of the metallic shaft 340dd. Therefore, it is difficult for the side cover 310B to deform, increasing thereby the strength (rigidity) of the positioning portion 310dd1.

Further, with the provision of the above described projections, the development roller 305 and coating roller 304 can be accurately positioned by the bearing members 340A and 340B alone. Thus, when attaching the side covers 310A and 310B after the attachment of the bearing members 340A and 340B, the bearing members 340A and 340B, and both rollers 304 and 305, will have been accurately positioned, making it easier to attach the side covers 310A and 310B. Therefore, it is easier to assembly a development cartridge 4.

The present invention made it possible to improve the efficiency with which the side cover was attached to the cartridge frame.

The present invention made it possible to improve the accuracy with which the side cover was positioned relative to the cartridge frame when attaching the side cover to the cartridge frame.

The present invention made it possible to increase the degree of solidness with which the side cover was attached to the cartridge frame.

Further, the present invention made it possible to make the metallic projection of the bearing member double as a member for reinforcing the side cover as the side cover was attached to the cartridge frame, preventing the side cover from deforming, or minimizing the deformation of the side cover, even though the position of the development cartridge relative to an electrophotographic image forming apparatus main assembly was fixed by a part of the side cover, when the development cartridge was in the main assembly of the image forming apparatus. Therefore, it was possible to increase the accuracy with which the development cartridge was positioned relative to the main assembly of the image forming apparatus.

While the invention has been described with reference to the structures disclosed herein, it is

not confined to the details set forth, and this application is intended to cover such modifications or changes as may come within the purposes of the improvements or the scope of the following claims.